SHARED SOCKET MULTI-CHIP MODULE AND/OR PIGGYBACK PIN GRID ARRAY PACKAGE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an electronic package for an integrated circuit.

2. Description of Related Art

Integrated circuits are typically housed within a package that can be mounted to a printed circuit board. One conventional type of IC package is a printed circuit board based housing which has a plurality of external pins, commonly referred to as a plastic pin grid array (PPGA) package. IC packages can also be constructed from a ceramic material that is co-fired and sealed with a lid. Although both types of packages are widely used, PPGA packages are popular because they are relatively inexpensive to produce.

IC packages are used to house high frequency semiconductive devices such as a microprocessor. High frequency devices are particularly sensitive to electrical noise on the power and the data signals transmitted between the package and the printed circuit board. Electrical noise can be reduced by soldering passive elements, such as a capacitor(s), to the printed circuit board. Attaching passive elements to the circuit board occupies valuable board space and increases circuit inductance.

Voltage regulators and power converters are typically coupled to an integrated circuit to control the power delivered to the circuit. To reduce the inductance length between the devices, it is desirable to place the voltage regulator/power converter into close physical proximity with the integrated circuit. Long trace lengths may increase the inductance and noise between devices.

Integrated circuits can contain millions of transistors which draw a significant amount of current, thus generating a relatively large amount of heat within the device. The heat must be removed from both the IC and the package. The thermal impedance of the package must be low enough to insure that the junction temperatures of the integrated circuit are maintained within safe operating limits. Thermally conductive heat slugs are sometimes incorporated into the package to improve the thermal efficiency in removing heat from the integrated circuit. It is therefore desirable to provide a relatively low cost PPGA package assembly that contains a heat slug, and both passive and active elements.

SUMMARY OF THE INVENTION

The present invention is an electronic package for housing an integrated circuit (IC). The package has a plurality of first pins extending from a plastic element. The pins are coupled to the integrated circuit and provide a means for mounting the package to an external printed circuit board. The package also has an internal circuit board that is coupled to both the plastic element and the IC by a plurality of second pins. Mounted to the circuit board are passive and/or active electrical elements that are connected to the integrated circuit through the second pins. Some of the second pins may extend entirely through the internal circuit board to directly couple the electrical elements to the external printed circuit board. To improve the thermal impedance of the package, the integrated circuit is mounted to a heat slug which can be attached to a heat sink. The heat sink may also provide a substrate for the internal circuit board.

BRIEF DESCRIPTION OF THE DRAWINGS

The objects and advantages of the present invention will become more readily apparent to those ordinarily skilled in the art after reviewing the following detailed description and accompanying drawings, wherein:

FIG. 1 is an exploded view of an electronic package of the present invention;

FIG. 2 is a cross-sectional view of an assembled electronic package of FIG. 1;

FIG. 3 is an exploded view of an alternative embodiment of the electronic package;

FIG. 4 is a cross-sectional view of an assembled electronic package of FIG. 3.

DETAILED DESCRIPTION OF THE INVENTION

Referring to the drawings more particularly by reference numbers, FIGS. 1 and 2 show an electronic package 10 of the present invention. The package 10 contains an integrated circuit 12. The integrated circuit 12 may be any type of semiconductive device, including but not limited to a microprocessor. The integrated circuit 12 is located within the inner cavity 14 of a plastic element 20. The plastic element 20 is attached to a first printed circuit board 18. The printed circuit board 18 may contain a plurality of conductive layers 22 and plated through holes 24. The integrated circuit 12 is typically coupled to the conductive layers 22 of the printed circuit board 18 by surface pads (not shown) located on both the circuit board 18 and the integrated circuit 12.

Attached to the plated through holes 24 are a plurality of first pins 26. The first pins 26 extend through the plastic element 20 and provide a means to mount the package 10 to an external printed circuit board (not shown). The pins 26 are coupled to the integrated circuit 12 by plated through holes 24 and conductive layers 22 of the printed circuit board 18. The integrated circuit 12 is enclosed within the inner cavity 14 by a lid 28. The lid 28 is typically bonded to the plastic body by an adhesive 30.

The package 10 further includes a second circuit board 32 which has a plurality of second pins 34 that couple the second board 32 with the first board 18. The ends of the second pins 34 are attached to the plated through holes 24 of the first board 18, and are coupled to conductive layers 36 within the second circuit board 32. Although rigged printed circuit boards are described, it is to be understood that the boards 18 and 32 can be constructed from a flexible polyimide material to create a flexible circuit board.

Mounted to the second circuit board 32 are a number of electronic devices 38*a* and 38*b*. The devices 38*a* and 38*b* are connected to the conductive layers 36 of the second circuit board 32 by leads 40. The electronic devices 38*a* and 38*b* are coupled to the integrated circuit 12 and the first pins 26 by the second pins 34 and the circuit board 32. The electronic devices 38*a* and 38*b* may be either passive or active elements. For example, device 38*a* may be a decoupling capacitor used to control the impedance of the package and the integrated circuit. The capacitor may have a relatively high capacitance to reduce the amount of noise on the signals transmitted between the integrated circuit 12 and the external printed circuit board. Device 38*b* may be a voltage regulator or a power converter that controls the power delivered to the integrated circuit 12. The devices 38*a* and 38*b* may be located within slots 42 of the circuit board 32 to reduce the profile of the package 10. The electronic devices may be housed within an outer casing.

To improve the thermal efficiency of the package 10, a heat slug 46 is attached to the first circuit board 18. The heat slug 46 is preferably constructed from a thermally conduc-